

Ultralightweight Refractory-Lined C/C Ascent Engine Combustion Chambers, Phase I

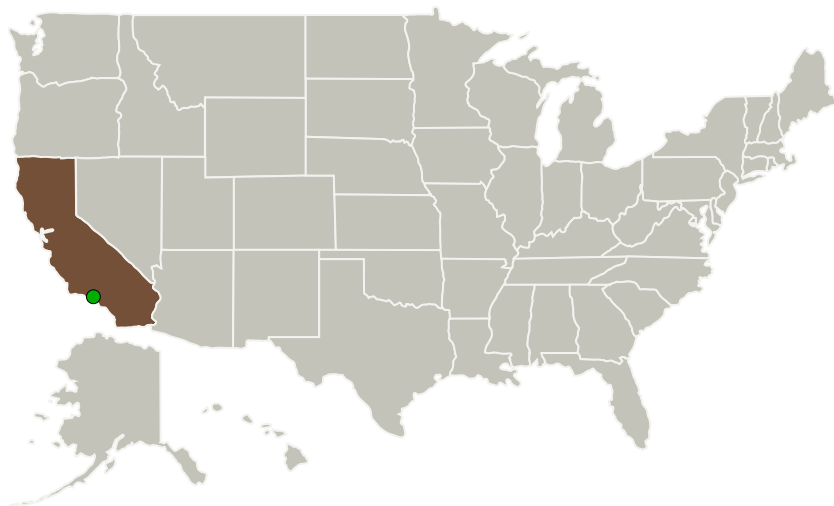
Completed Technology Project (2014 - 2014)



Project Introduction

Mars sample return ascent vehicles require a velocity change exceeding 4 km/s within minutes of launch and higher propellant mass fractions than are offered by current pressure-fed satellite propulsion systems. Pump-fed systems are potentially low-mass, but a suitable high-pressure nitrogen tetroxide/monomethyl hydrazine (NTO/MMH) bipropellant rocket engine remains to be developed. The state of the art in NTO/MMH combustion chambers is iridium-lined rhenium (Ir/Re) manufactured by Ultramet and used by Aerojet in its HiPAT engine. In previous and current work, Ultramet has demonstrated the potential for fabrication of refractory metal and ceramic matrix composite (CMC)-lined carbon/carbon (C/C) components, thereby combining the benefits of the refractory liner with the substantially reduced weight and cost of C/C. The shortfall of using C/C as the lightweight structure is the disparity in thermal expansion, causing highly stressed components. In this project, Ultramet will demonstrate a processing route to integrally bond liners of a zirconium carbide (ZrC) CMC and of rhenium to C/C that will be applied to the fabrication of a Mars sample return ascent engine combustion chamber. Phase II will culminate in the design and fabrication of a 1000-N, 500-psi refractory-lined C/C chamber that will be delivered to NASA. To facilitate testing within project funding resources, a 22-N 500-psi refractory-lined C/C chamber will also be designed, fabricated, and hot-fire tested at one of the major propulsion system integrators (Aerojet, Moog-ISP, or Northrop Grumman), all of which have expressed interest in teaming on the project.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Ultramet	Lead Organization	Industry	Pacoima, California
● Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations

California

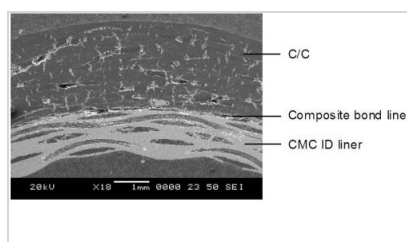
Project Transitions

**June 2014:** Project Start**December 2014:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140115>)

Images



Briefing Chart

Ultralightweight Refractory-Lined
C/C Ascent Engine Combustion
Chambers, Phase I
(<https://techport.nasa.gov/image/136968>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Ultramet

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

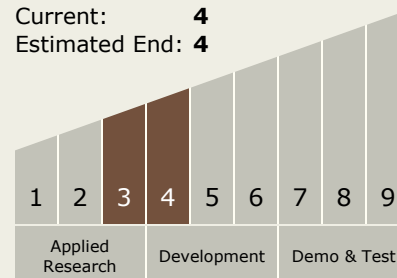
Program Manager:

Carlos Torrez

Principal Investigator:

Matthew J Wright

Technology Maturity (TRL)

Start: **3**Current: **4**Estimated End: **4**

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Technology Areas

Primary:

- TX01 Propulsion Systems
 - └ TX01.1 Chemical Space Propulsion
 - └ TX01.1.2 Earth Storable

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System